RCRA FACILITY INVESTIGATION (RFI) REPORT

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GM TRUCK GROUP
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CERTIFICATION

"I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to evaluate the information submitted. I certify that the information contained in or accompanying this submittal is true, accurate, and complete. As to those identified portion(s) of this submittal for which I cannot personally verify the accuracy, I certify that this submittal and all attachments were prepared in accordance with procedures designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the information, or the immediate supervisor of such person(s), the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations."

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<u>LIST OF ACRONYMS</u>

AMSL	Above Mean Sea Level
AOC(s)	Area(s) of Concern
AOIs	Areas of Interest
ASTs	Above-ground Storage Tanks
BGS	Below Ground Surface
BHHRA	Baseline Human Health Risk Assessment
BKSF	Biokinetic Slope Factor
CDM	Camp Dresser and McKee
CAS	Columbia Analytical Services
CDC	Center for Disease Control
CDI	Chronic Daily Intake
CET	Carlo Environmental Technologies
CMS	Corrective Measures Study
COPC	Contaminant of Potential Concern
Consent Order	Administrative Order on Consent
CRA	Conestoga-Rovers & Associates
CRP	Community Relations Plan
CSF	Cancer Slope Factor
DCC	Direct Contact Criteria
DMP	Data Management Plan
DWP	Drinking Water Protection
ERD	Environmental Response Division
FSP	Field Sampling Plan
GCPC	Groundwater Contact Protection Criteria
GM	General Motors Corporation
GSD	Geological Survey Division
GSI	Groundwater/Surface Water Interface
HASP	Health and Safety Plan
HQ	Hazard Quotient
HSA	Hollow-stem Auger
ID	Insufficient Data
IM	Interim Measures

LIST OF ACRONYMS (CONT'D)

LUST	Leaking Underground Storage Tank
MDEQ	Michigan Department of Environmental Quality [formerly the Michigan Department of Natural Resources(MDNR)]
MDPH	Michigan Department of Public Health
NCP	National Contingency Plan
ND	Non-detect
NPDES	National Pollution Discharge Elimination System
OSWER	Office of Solid Waste and Emergency Response
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PMP	Project Management Plan
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
ppm	parts per million
PRE	Preliminary Risk Evaluation
PR/VSI	Preliminary Review/Visual Site Inspection
PSIC	Particulate Soil Inhalation Criteria
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAGS	Risk Assessment Guidance for Superfund
RBRG	Risk-based Remediation Goal
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RFI	RCRA Facility Investigation
RME	Reasonable Max Exposure
SOW	Scope of Work
SVOCs	Semi-Volatile Organic Compounds
SWMU	Solid Waste Management Unit
TCL/TAL	Target Compound List/Target Analyte List
TCLP	Toxicity Characteristic Leachate Procedure

LIST OF ACRONYMS (CONT'D)

TICs	Tentatively Identified Compounds
TPC	Truck Product Center
UCL	Upper Confidence Limit
U.S. EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

1.1 GENERAL

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report was prepared by Conestoga-Rovers & Associates, Inc. (CRA) for the General Motors Corporation (GM) Truck Group Facility (Facility) in Pontiac, Michigan. The Facility location is presented on Figure 1.1. A Facility Plan is presented on Figure 1.2. This document summarizes the methodologies and results of the investigative field activities completed by CRA at the Facility during two primary phases of investigation.

The first phase of RFI investigative activities was conducted between November 1998 and January 1999 and focused on characterizing soil environmental quality within and adjacent to five Solid Waste Management Units (SWMUs) identified by the United States Environmental Protection Agency (U.S. EPA) in a RCRA 3008(h) Administrative Order on Consent (Consent Order) with GM. The Consent Order, which was executed by U.S. EPA on September 24, 1998, required GM to initiate investigative/corrective actions at the Facility pursuant to Section 3008h of RCRA. The RFI was completed in general accordance with the specifications outlined in the September 4, 1998 RFI Work Plan (CRA, 1998) and associated Quality Assurance Project Plan (QAPP) for the Facility which were approved by the U.S. EPA on September 11, 1998 and September 23, 1998, respectively. The seven SWMUs which were addressed pursuant to the Consent Order are summarized below.

	SWMU	*Description*	*Scope*
1)	#30	Former J-Lot Fill Area	Interim Measure (IM)
2)	#32	Former Coal Pile Storage Area	IM
3)	#3	Container Storage Area	RFI
4)	#29	Wastewater Treatment Plant	RFI
5)	#31	Former Surface Impoundment	RFI
6)	#33	Former South Retention Pond	RFI
7)	#34	North Retention Pond	RF

The results of the first phase of RFI field activities were compiled and transmitted to U.S. EPA for review in the RFI Report dated July 19, 1999. GM received comments on the July 19, 1999 RFI Report in correspondence from U.S. EPA dated July 12, 2000. The July 12, 2000 U.S. EPA correspondence included comments on the RFI Report and a request for limited supplemental RFI investigations.

The limited supplemental RFI investigative activities were conducted in accordance with the RFI Work Plan Addendum dated July 27, 2000 which was approved by the U.S. EPA on August 2, 2000. The results of the limited supplemental RFI investigative activities were transmitted to U.S. EPA in a document entitled "Addendum No. 1 to RCRA Facility Investigation (RFI) Report" dated November 21, 2000. (Addendum No. 1 to RFI Report, CRA November 2000).

In addition to the request for limited supplemental investigations on July 12, 2000, U.S. EPA also provided GM with several comments on the original July 19, 1999 RFI Report. GM's responses to the July 12, 2000 U.S. EPA comments were transmitted to U.S. EPA on August 17, 2000 and approved by U.S. EPA in correspondence dated September 29, 2000.

This document presents a compilation of the information generated from the above referenced activities which are summarized as follows:

1. the results of the Phase I RFI activities completed between November 1998 and January 1999 which were reported to U.S. EPA in the original RFI Report (CRA, July 19, 1999).
2. the results of the Phase II RFI activities completed in August 2000 which were reported to U.S. EPA in the Addendum No. 1 to RFI Report (CRA, November 21, 2000).
3. GM's responses dated August 17, 2000 to U.S. EPA's comments dated July 12, 2000 on the RFI Report (CRA, July 19, 1999) which were approved by U.S. EPA on September 29, 2000.

1.2 INTERIM MEASURES

Investigations and corrective actions for two additional SWMUs at the Facility were addressed by GM through RCRA Interim Measure (IM) programs. As summarized below, the IM's were completed at SWMU #30, the Former J-Lot Fill Area, and SWMU #32, the Former Coal Pile Storage Area. Both IM's were completed concurrently with the RFI Work Plan (CRA, 1998) development and implementation. The scope and results of the IM activities were submitted to the U.S. EPA in CRA reports entitled RCRA Interim Measures Construction Certification Report, Former J-Lot Fill Area (CRA, 1998a) and RCRA Interim Measure Investigation and Design Report, SWMU #32, Former Coal Pile Storage Area (CRA, 1999), respectively. The IMs at the Former J-Lot

Fill Area (SWMU #30) and the Former Coal Pile Storage Area (SWMU #32) were both approved by U.S. EPA in correspondence dated June 11, 1998 and June 15, 2000, respectively.

The remainder of Section 1.0 presents a summary of pertinent background information on the Facility.

1.3 FACILITY HISTORY

In 1927, the Facility began producing medium and heavy duty trucks and buses at the former Pontiac Central Manufacturing and Assembly Plant, which was formerly located in the northwest corner of the Facility. Major manufacturing activities associated with the production of these vehicles included machining, stamping, plating, smelting, fiberglass laminating, heat treating, painting, and sealing. Subsequent operations were expanded to include more than 60 manufacturing and office buildings, the biggest of which was the GM Pontiac East Assembly Plant (which is currently located in the southeast corner of the Facility). An aerial photograph of the Facility in 1985 is presented on Figure 1.3. The Facility Plan from 1987 is presented on Figure 1.4. These figures present the Facility conditions prior to closing and the initiation of significant brownfield redevelopment activities as the Centerpoint Business Campus.

In August 1990, manufacturing operations at the former Pontiac Central Manufacturing and Assembly Plant were discontinued. Between 1991 and 1995, the plant was environmentally decommissioned and the area was redeveloped as the GM Truck Product Center (TPC) Central, the "hub" of the Centerpoint Business Campus, which is a large scale industrial and commercial business development. An aerial photograph of the GM TPC Central from 1995 is presented on Figure 1.5. The building depicted on Figure 1.5, which is currently used as an engineering center, was previously a portion of the former Pontiac Central Manufacturing and Assembly Plant. Figure 1.6 provides a current overview of the expansion and redevelopment activities proposed for the Facility. An overview of the planned development activities, as proposed by Etkin Equities (August 1999), is presented on Figures 1.7 and 1.8.

As part of this redevelopment, the Facility was divided into three major parcels of land, including Parcels "A", "B", and "C". Parcel "A" includes the GM TPC Central and part of the Centerpoint Business Campus, which is predominately used as office, design, and engineering areas. Parcel "B", which was subdivided into parcels B1, B2, and B3, contains GM TPC East, the former South Retention Pond (SWMU #33), and the North

Retention Pond (SWMU #34). Parcel "C", which was subdivided into parcels C1, C2, C3, and C4, contains the truck Engineering Center, the Pontiac East Assembly Plant, the Container Storage Area (SWMU #3), the Waste Water Treatment Plant area (SWMU #29), and the former Surface Impoundment (SWMU #31). Access roads were constructed throughout the Facility to connect the parcels and the campus development (i.e., Centerpoint Parkway and Campus Drive). Figure 1.9 provides a map showing the Facility layout, the location of the five SWMUs, and the two SWMUs that were addressed under the IM program (SWMU #30 and SWMU #32).

1.4 RFI OVERVIEW

In March 1987, a Preliminary Review/Visual Site Inspection (PR/VSI) Report was prepared by A.T. Kearney, Inc. and K.W. Brown and Associates, Inc. on behalf of U.S. EPA (U.S. EPA, 1987). The PR/VSI identified 31 SWMUs and six Areas of Concern (AOC) at the GM Facility.

On September 1, 1987, as a follow-up to the PR/VSI, the U.S. EPA performed a RCRA inspection of the Facility. During the inspection, the U.S. EPA collected 11 soil samples. Of these 11 samples, six were located within defined boundaries of four of the SWMUs being addressed in this RFI Report. The U.S. EPA did not collect any samples from SWMU #3 - Container Storage Area. A breakdown of the soil samples collected by the U.S. EPA in each of the relevant SWMUs is summarized below. Results of the U.S. EPA sampling activities were presented in the RFI Work Plan (CRA, 1998b).

SWMU	*Description*	*Number of Samples*
#3	Container Storage Area	0
#29	Wastewater Treatment Plant	1
#31	Former Surface Impoundment	1
#33	Former South Retention Pond	2
#34	North Retention Pond	2

Following the August 17, 1995 meeting between GM and the U.S. EPA, GM identified an additional 43 Areas of Interest (AOIs) in its independent review of existing environmental conditions at the Facility. The historical operations and wastes managed at each of the SWMUs/AOIs were described in detail in two documents entitled Review of Existing Conditions Report (CRA, 1995a), and Supplemental Review of Existing Conditions Report (CRA, 1995b). These two reports also included information from interviews with Facility managers, existing analytical data from the SWMUs/AOIs, and information on the Facility-specific geologic/hydrogeologic conditions at the Facility.

Based on U.S. EPA's review of reports and the Facility conditions, the Consent Order required further action at seven SWMUs. Investigative activities to address five of the seven areas were summarized in the September 4, 1998 U.S. EPA-approved RFI Work Plan (CRA, 1998b). The remaining two areas were addressed as Interim Measures as discussed in Section 1.2. The RFI Work Plan (CRA, 1998b) also included the following support information and project plans:

- SWMU Photographic Log (photographs from 1995 and 1997);
- Project Management Plan (PMP);
- Quality Assurance Project Plan (QAPP);
- Data Management Plan (DMP);
- Health and Safety Plan (HASP);
- Community Relations Plan (CRP);
- Field Sampling Plan (FSP); and
- Historical Analytical Results (Appendix H).

As indicated above, Appendix H of the RFI Work Plan (CRA, 1998b) presented supplemental analytical results from previous U.S. EPA data collection activities at four (#29, #31, #33, and #34) of the five SWMUs (no sampling results were available for SWMU #3 - Container Storage Area). The analytical data from the GM and U.S. EPA sampling activities were used in conjunction with historical operations information to design the sampling strategy for each SWMU investigation. These sampling strategies were summarized in Table 1.4 of the RFI Work Plan (CRA, 1998b) and are discussed in more detail in Section 3.0 of this RFI Report.

1.5 RFI OBJECTIVES

As specified in the RFI Work Plan (CRA, 1998b), surface and subsurface soil samples were collected from investigative boreholes installed at each of the five SWMUs (#3, #29, #31, #33, and #34) and sediment samples were also collected from SWMU #34 during the Phase I RFI investigation. In addition, perched groundwater samples were collected from SWMU #3 and SWMU #31 during the Phase II RFI investigation. Combining the historical information available for each SWMU, with the analytical data from the two phases of RFI sampling activities, the objectives of the RFI were to:

- characterize potential source(s) of hazardous constituents;
- define the nature and extent of hazardous constituents in environmental media, if any;
- characterize the potential migration pathways, if any, of hazardous constituents;
- identify actual or potential environmental receptors;
- provide the data necessary to complete the RFI Report including a Preliminary Risk Evaluation, if required; and
- determine whether a Corrective Measures Study (CMS) is required based on the Preliminary Risk Evaluation.

1.6 RFI REPORT ORGANIZATION

The RFI Report is organized as follows:

- Section 2.0 Environmental Setting;
- Section 3.0 RFI Scope of Work Methodologies;
- Section 4.0 RFI Summary;
- Section 5.0 Results of RFI;
- Section 6.0 Preliminary Risk Evaluation;
- Section 7.0 Summary, Conclusions, and Recommendations; and
- Section 8.0 References.

The RFI Report includes the following appendices:

- Appendix A Stratigraphic and Instrumentation Logs;
- Appendix B Laboratory Analytical Data Reports;
- Appendix C Soil Cuttings Waste Characterization Analytical Results;
- Appendix D Laboratory Assessment and Validation Reports;
- Appendix E MDEQ Generic Cleanup Criteria and Screening Levels; and
- Appendix F Preliminary Risk Evaluation Calculations.

2.0 ENVIRONMENTAL SETTING

2.1 FACILITY LOCATION

As shown on Figure 1.1, the Facility is located in Sections 3 and 4 of Township T2N, Range R10E, City of Pontiac, Oakland County, Michigan. The Facility encompasses approximately 350 acres of land and currently contains the Centerpoint Business Campus which includes the GM Pontiac East Assembly Plant (U.S. EPA ID No. MID 005 356 902). The Facility formerly contained the Pontiac Central Manufacturing and Assembly Plant. The Facility is generally bordered by South Boulevard to the north, the Grand Trunk Western Railroad to the south, Opdyke Road to the east, and East Boulevard/Martin Luther King Jr. Boulevard to the west. A Facility plan is presented on Figure 1.2.

2.2 SURROUNDING LAND USE

The surrounding land uses to the north and west of the Facility are presented on Figure 2.1. Land uses to the south, west, and east of the Facility are presented on Figure 2.2. The surrounding land uses on the east and south sides of the Facility are residential. The land use to the north, and west of the Facility is a mixture of industrial/commercial. Land uses at and surrounding the Facility are summarized as follows:

Location	*Jurisdiction*	*Land Use*
Facility	City of Pontiac	Industrial/Commercial
North	City of Pontiac	Industrial/Commercial
East	Bloomfield Township	Residential
South	Bloomfield Township	Residential
West	City of Pontiac/Bloomfield Township	Industrial/Commercial

2.3 DEMOGRAPHICS

The populations within a three-mile, five-mile, and ten-mile radius of the Facility, in 1990 and 1994, are estimated below:

	Population		
Location	*1990*	*1994*	*% Change (1990-1994)*
Three-mile	53,130	54,519	+2.6
Five-mile	171,040	174,349	+1.9
Ten-mile	708,384	729,197	+2.9

2.4 REGIONAL AND SITE SETTING

A detailed description of the regional geology, hydrogeology, hydrology, and climatological data were presented in the RFI Work Plan (CRA, 1998b). The information was obtained from published regional information, as well as other subsurface investigations performed on or in the vicinity of the Facility. The detailed information that was presented in the RFI Work Plan (CRA, 1998b) is summarized below.

2.4.1 GEOLOGY

The regional geologic profile typically consists of three distinct units, including: (1) a surficial fill and/or a native granular horizon; (2) a glacial till deposit; and (3) a Mississipian-aged bedrock (Coldwater Shale) (see Figures 2.3 and 2.4). In areas of the Facility, the surficial fill materials are typically comprised of a variable mix of sand, gravel, clay, asphalt, concrete, and other engineered fill. The fill unit ranges in depth from approximately 5 to 15 feet below grade. Below the fill material, up to 350 feet of glacial material is encountered. This glacial material generally consists of a medium-textured, poorly stratified clay till with thin, laterally discontinuous lenses of silts, sands, and/or gravels. However, in the vicinity of the Facility, the glacial till does contain several interbedded laterally continuous sand layers of variable thickness between 120 and 350 feet below grade. This includes a glacial outwash deposit of well-sorted sand and gravel at approximately 220 feet below grade.

Well logs from production wells at the Facility and supply wells off of the Facility were obtained and reviewed in the Review of Existing Conditions Report (CRA, 1995a) and supplemented through a request to the MDEQ Geologic Survey Division in September/October 2000. The locations of these well logs are presented on Figure 2.5.

A generalized east-west geologic cross-section in the vicinity of the Facility is presented on Figure 2.6. Well logs obtained in a radius of approximately 1 mile of the Facility are presented in Appendix A.""

Depth to bedrock in the vicinity of the Facility ranges from approximately 250 to 350 feet below grade. The surface elevation of the bedrock unit is approximately 625 to 650 feet above mean sea level (AMSL). The Coldwater Shale may be as much as 1,300 feet thick in the vicinity of the Facility and is generally described as dark brown to black, bituminous, fissile, and finely laminated.

2.4.2 HYDROGEOLOGY

Groundwater is encountered within the surficial fill/granular material, the glacial till deposits, and the underlying bedrock unit. Depth to groundwater, groundwater quality, and groundwater quantity vary between and within the geological units.

Within the shallow surficial fill/granular horizon, groundwater is encountered in unconfined "perched" conditions (accumulating on top of the clay till). It's presence and saturated thickness are influenced by seasonal precipitation, local drainage patterns, and surficial geology. In the area of the Facility, the perched groundwater is occasionally encountered at depths of approximately 10 to 20 feet below grade and is laterally discontinuous. The shallow perched water table zone is generally not utilized for water supply purposes in the Pontiac area. In addition, the use of this zone as a potable supply would be generally prohibited by Michigan Department of Public Health regulations (i.e., it is at a depth of less than 25 feet) [Part 127 of Act 368 (Groundwater Quality Control), 1978].

Within the glacial till, groundwater has been encountered in confined conditions within the interbedded sand units and the outwash deposits encountered approximately 120 to 250 feet below grade. According to a 1981 hydraulic assessment of the Facility completed by Camp, Dresser, and McKee (CDM, 1981), three sand and sand/gravel aquifers were identified beneath the GM property at depths of approximately 120, 150, and 210 feet bgs, respectively. Within the study area, the units are approximately 7, 25, and 50 feet thick, respectively. These interbedded sand units are considered regional aquifer(s) and formerly supplied the Facility with an industrial water supply (until the late 1980's when the GM production wells were decommissioned). These interbedded sand aquifers are separated from the perched groundwater by approximately 100 feet of -glacial clay till. This glacial clay has an estimated hydraulic conductivity on the order of 10^{-6} cm/s to 10^{-9} cm/s based upon published values (Fetter, 1994 and Kasenow, 1997) for glacial clay till and acts as an aquitard, restricting vertical movement from the shallow perched zone (when present) to the top of the interbedded sand aquifer encountered approximately 120 feet below grade. As a result, there is no vertical migration pathway for potentially impacted perched groundwater.

Below the overburden aquifers, the Coldwater Shale is commonly considered a nonproductive aquifer, typically yielding only small amounts of water. A more abundant water supply is found at greater depths and with significant increases in mineral content (i.e., brines). The bedrock water resources, like the more usable lower sand and gravel aquifer above them, are considered to be protected from surficial contamination (see Figures 2.7 and 2.8). Therefore, the drinking water exposure pathway for groundwater for these five SWMU can be eliminated.

2.4.3 HYDROLOGY

The Facility is located within both the Clinton River and Rouge River drainage basins (see Figure 2.9). The Clinton River, which is located approximately 0.85 miles northeast of the Facility, flows easterly and discharges into Lake St. Clair. The Rouge River, which is located approximately 3.0 miles southeast of the Facility, flows to the southwest prior to turning east and discharging into the Detroit River (below Lake St. Clair). Several surface water bodies and intermittent drains are also located within a mile of the Facility. The closest of these include Hadsells Pond, which is located approximately 2,000 feet west of the Facility and Hamlin Drain, which is located off the southeast corner of the Facility. There are no natural surface water bodies on the Facility and therefore the groundwater/surface water interface (GSI) exposure pathway was eliminated from further review.

2.4.4 CLIMATE

The prevailing winds are from the northwest in the winter, and the southwest in the summer months. The prevailing wind direction and speed for the region are presented on Figure 2.10. Precipitation data for the period 1931 through 1960, inclusive, indicate the mean annual precipitation to be 30.68 inches with 56 percent of the total precipitation falling during the period from May through October. Pontiac is located in an area of temperate climate having average daily temperatures of 25°F and 72°F for January and July, respectively.

2.5 POTENTIAL RECEPTOR IDENTIFICATION

The potential receptor identification review was performed to identify potential human, fauna, and flora receptors of possible Facility-related constituents that may migrate through environmental media of concern.

2.5.1 LAND USE

The land on site is used for industrial and commercial purposes. Access within the industrial portions of the Facility is restricted through the use of security fences and security guards. Land use in the vicinity of the Facility is used for residential and commercial purposes (see Figure 2.1/2.2). Land use at the Facility is expected to remain industrial or commercial into the reasonably foreseeable future. As a result, current and future potential receptors include trespassers, construction workers, or Facility employees.

2.5.2 POTABLE WATER USE

Water for potable and industrial uses is supplied to the Facility by the City of Pontiac. As a result, the groundwater pathway is reasonably expected to remain incomplete in the future.

2.5.3 GROUNDWATER USE

Shallow perched groundwater, to the extent it is present, is not used at the Facility for any use. In many locations the perched water is absent altogether. In addition, as identified in Section 2.5.2, shallow (i.e., <25 feet) perched groundwater use would be generally prohibited by Michigan Department of Public Health regulations. As a result, the shallow groundwater pathway is reasonably expected to remain incomplete in the future.

2.5.4 GROUNDWATER/SURFACE WATER INTERFACE

As discussed in Section 2.4.3, there are no natural surface water bodies at the Facility. Therefore, the groundwater/surface water (GSI) interface exposure pathway was eliminated from further review.

2.5.5 ECOLOGICAL CHARACTERISTICS

The majority of the Facility is used for industrial or commercial activities and contains very little natural flora or habitat for fauna. SWMU #34 is an active stormwater retention basin and therefore, has the potential for limited habitat for some flora and fauna. It should also be noted that many portions of the Facility have been landscaped within recent years as part of the Centerpoint Business Campus development. As a result, there are no significant environmental receptors within the identified SWMUs.

2.6 SCREENING LEVELS

Generic risk based industrial cleanup criteria are specified in Part 201 of Michigan's Natural Resources and Environmental Protection Act, Public Act 451, and outlined in the Michigan Department of Environmental Quality (MDEQ) Environmental Response Division (ERD) Operational Memorandum No. 18, revised June 6, 2000 (MDEQ, 2000). This risk-based industrial criteria provides land-use specific screening levels for evaluation of SWMU-specific analytical data (i.e., the risk-based industrial criteria provides a "starting point" for evaluation of SWMU-specific data).

Validated soil sample analytical data were compared to the risk-based standards presented below.

- Generic Industrial Direct Contact Criteria (DCC);
- Volatile Soil Inhalation Criteria (VSIC) for Ambient Air;
- Groundwater Contact Protection Criteria (GCPC);
- Particulate Soil Inhalation Criteria (PSIC); and
- Soil Volatilization to Indoor Air (for potential future land uses).

Several other generic industrial soil cleanup criteria were listed in the MDEQ Operational Memorandum No. 18. However, after assessing the criteria, they were determined not to be applicable to Facility conditions and were eliminated from consideration. These criteria include the Groundwater/Surface Water Interface (GSI) Criteria, and the Drinking Water Protection (DWP) Criteria. The GSI criteria was eliminated based on the absence of natural surface water bodies on or adjacent to the Facility. The DWP criteria was eliminated based on Michigan Department of Public Health (MDPH) regulations and previous geologic characterization at the Facility. The MDPH regulations (Part 127 of Act 368) prohibit drinking water wells at a depth of less than 25 feet, which would exclude the limited non-potable water that may be present within the surficial fill material or within the thin, shallow, discontinuous sand lenses as a source of drinking water. Additionally, municipal water is available at the Facility, and the potentially potable groundwater encountered approximately 120 feet below grade is protected by approximately 100 feet of glacial clay till. This glacial till has an estimated hydraulic conductivity of less than 10^{-7} cm/sec and acts as an aquitard, restricting vertical movement and/or migration of contaminants.

Based on an evaluation of the applicable MDEQ generic industrial cleanup criteria, the generic industrial Direct Contact Criteria (DCC) is generally the most applicable and stringent for the conditions identified at the Facility. Therefore, although all the criteria listed above were compared to the analytical results from the RFI, only the DCC criteria are listed in the data tables to compare, assess, and identify potential risks associated with the chemical constituents detected during the investigation. As indicated above, the DCC and other applicable criteria are summarized in MDEQ Operational Memorandum No. 18, which is presented in Appendix E.

3.0 RFI SCOPE OF WORK AND METHODOLOGIES

3.1 GENERAL

The RFI was implemented to characterize the nature and extent of Facility-derived constituents which may be present at each SWMU as a result of previous operations and/or releases. The potential chemical constituents and associated soil and groundwater quality at each SWMU were investigated by installing at least three boreholes in each study area. The borehole locations, borehole depths, number of samples collected, the parameters analyzed, and the procedures/methodologies utilized to investigate each SWMU were based on information presented in the Review of Existing Conditions Report (CRA, 1995a) and the Supplemental Review of Existing Conditions Report (CRA, 1995b).

The sampling activities for the RFI were completed in two phases between December 1998 and January 1999, and in August 2000. All subsurface drilling activities were conducted by Carlo Environmental Technologies (CET) of Clinton Township, Michigan or Altech Services L.L.C. of Southfield, Michigan. Analytical laboratory services were provided by Columbia Analytical Services, Inc. (CAS) of Kelso, Washington. Surveying activities were completed by CRA .

The remainder of this section summarizes the field activities and the methodologies utilized during the RFI (as specified in the U.S. EPA-approved RFI Work Plans). Any deviations from these methodologies are discussed in the subsequent section (Section 4.0), which describes each SWMU, and summarizes the SWMU-specific investigations.

3.2 SOIL BORING AND SOIL SAMPLING

Between December 2 and 18, 1998, CET completed the Phase I RFI investigation drilling program under the direct supervision of CRA. The boreholes were advanced using a drill rig equipped with 4.25-inch inside diameter (ID) hollow stem augers (HSA) and two foot-long stainless steel split spoons. Boreholes were completed to depths ranging between 2 and 42 feet below grade (the deepest boring installed during the RFI). All sampling equipment was decontaminated prior to field use and after each sample was collected to prevent cross contamination between samples. Decontamination procedures were consistent with those outlined in the QAPP. Soil boring stratigraphic logs are presented in Appendix A.

3.2.1 SOIL SAMPLE SCREENING AND LABELING

Soil samples collected during the RFI were screened in the field with a photoionization detector (PID) equipped with the 10.2 EV lamp to assess the relative presence and concentrations of volatile organic compounds within each sample. The field screening activities were conducted in accordance with the specifications outlined in the RFI Work Plan. Upon completion of the sampling activities, boreholes were abandoned with bentonite chips to grade level.

Soil borings completed during the RFI were designated with a suffix that included the SWMU number and the boring number. For example, the first borehole completed at SWMU #3 was designated as BH-3-1, while the second borehole was designated as BH-3-2. Individual soil samples collected from each borehole were designated to include the sample type (surficial "SS", subsurface "S", or sediment "SD"), the CRA project number (7097), the collection date (m/d/y), the samplers initials (TJ or DS), and the sample number (in numerical sequence utilizing a 3-digit code). Due to previous sample numbers assigned during the interim measures investigations, the sample numbers associated with the five SWMUs started with number 019 and ended with number 067. These 49 samples included duplicate, matrix spike, and equipment blank samples, which were designated using the same numbering system to prevent laboratory bias of field QC samples.

3.2.2 SOIL SAMPLE ANALYSIS

After completing the sampling activities, select soil samples from each borehole were submitted for chemical analysis. The samples selected typically included a shallow surficial soil sample and/or a subsurface soil sample, depending on the RFI Work Plan (CRA, 1998b) specifications. If no staining or PID readings were present, the surficial soil sample was collected in the 0 to 2 foot below ground surface (bgs) interval. Samples being submitted for a volatile organic compound (VOC) analysis were collected below the 6-inch depth interval. The subsurface soil samples selected for chemical analysis were generally collected from the interval exhibiting the most staining or highest PID response.

Soil samples selected for chemical analysis were submitted to Columbia Analytical Services, Inc. for one or more of the following analyses:

- Target Compound List (TCL) VOCs by U.S. EPA Method 8260B;
- TCL semi-volatile organic compounds (SVOCs) by U.S. EPA Method 8270C;
- TCL polychlorinated biphenyls (PCBs) by U.S. EPA Method 8082;
- Target Analyte List (TAL) inorganic constituents (metals) by U.S. EPA 6010B, 6020, and 7470A;
- Total cyanide and sulfide by U.S. EPA Methods 9010B and 9030B, respectively; and
- U.S. EPA Appendix IX VOCs, SVOCs, PCBs (excluding pesticides, herbicides, dioxin, and furans) and/or metals using the same analytical methods referenced above.

Duplicate soil samples collected during the investigation were submitted for analysis at a frequency of 1 per 10 investigative samples. The Appendix IX samples were submitted for analysis at a frequency of 1 per 10 investigative samples or a minimum of one Appendix IX sample per SWMU. The TCL, TAL and Appendix IX parameter/analyte lists are presented in Tables C.1.1 and Table C.1.2 of the QAPP (CRA, 1998b), respectively. The summary of analytical methods is presented in Table C.7.1 of the QAPP (CRA, 1998b).

Matrix spike or matrix spike duplicate samples collected during the investigation were submitted for analysis at a frequency of 1 per 20 investigative samples. Equipment blank samples (rinsate samples) collected during the investigation were submitted for analysis at a frequency of 1 per 10 investigative samples. Soil sample analytical reports are presented in Appendix B.

3.3 MONITORING WELLS AND GROUNDWATER SAMPLING

As specified in the RFI Work Plan (CRA, 1998b), groundwater samples were to be collected at each SWMU if a significant groundwater aquifer was encountered during the soil boring program (in which case three of the soil borings installed at each study area were to be completed as monitoring wells). The monitoring wells were to be installed if the native porous media encountered throughout the study area was greater than 5 feet thick and the zone of saturation was greater than 2 feet thick. The monitoring wells were to be developed, purged, and sampled for the TCL/TAL constituents identified above. However, as identified in Section 2.4 of this RFI Report (and in previous investigations), the subsurface soils at the Facility are predominately glacial clay tills. As a result, a groundwater aquifer was not encountered immediately below any of the SWMUs during the Phase I RFI investigation. Therefore, groundwater samples were not collected during the first phase of the RFI investigation.

Based upon comments received from U.S. EPA on July 12, 2000, it was agreed that perched water table zone monitoring wells would be installed and sampled at SWMU #3 and SWMU #31. These monitoring wells were installed and sampled during the Phase II RFI investigation in August 2000. Additional details on the Phase II RFI investigation are presented in Section 4.2.

3.4 SAMPLE VALIDATION

After receiving the soil and groundwater sample analytical results from the laboratory, CRA's quality assurance officer completed a data quality assessment and validated the data using evaluation methodologies specified in the QAPP. The quality assurance/quality control (QA/QC) evaluation included a review of the laboratory blank data, as well as recovery data from matrix and surrogate spikes and check samples. The analytical data were also assessed for accuracy and precision based on the review of the spike recovery data. Analytical data quality assessment and validation reports for the Phase I and Phase II investigations are presented in Appendix D.

3.5 SURVEYING

After completing the boring program, the horizontal coordinates and vertical elevation (ground surface) of each borehole was surveyed to the nearest 0.01 feet by CRA. The data were used to prepare the figures for this RFI report.

3.6 WASTE DISPOSITION

Soil cuttings, development liquids, decon water, and used personal protective equipment (PPE) from the investigative activities were containerized in 55-gallon drums. The drums were appropriately labeled, and staged at the container storage pad at the wastewater treatment plant. The soil materials were subsequently sampled by GM and transported as non-hazardous material to the ECDC Environmental, Inc. disposal facility in East Carbon, Utah on April 7, 1999. The minor amount of decontamination fluids were subsequently discharged to the WWTP. Analytical results for the soil wastes are presented in Appendix C.

4.0 RFI INVESTIGATION SUMMARY

The RFI field activities were completed at the Facility during two phases of the RFI investigation:

- Phase I RFI Field Investigation: Soil; and
- Phase II RFI Field Investigation: Perched Water Table Zone.

The investigative activities are discussed in the following sections.

4.1 PHASE I RFI FIELD INVESTIGATION: SOIL

This section of the RFI Report presents a description of each of the five SWMUs, a summary of the SWMU-specific investigation activities (Table 4.1), and a summary of the samples collected at each location (Table 4.2) during the Phase I RFI investigation. The results of the investigative activities are presented in Section 5.0.

4.1.1 SWMU #3 - CONTAINER STORAGE AREA

A. SWMU #3 DESCRIPTION

The Container Storage Area was constructed in 1986 outside the southwest corner of Pontiac East Assembly Plant (see Figure 4.1). It consists of a concrete containment pad measuring approximately 50 feet wide by 100 feet long. The concrete pad was constructed with a self-contained spill collection trench and sump and is surrounded with a 6 to 8 inch concrete berm for secondary containment. The container storage area is used for the temporary accumulation (less than 90 days) of 55-gallon drums containing waste solvents and sludges, as well as non-hazardous materials, from ongoing operations at the Pontiac East Assembly Plant. As a result, the Container Storage Area does not require a RCRA permit.

After 1995, a concrete slab was constructed on the east and south sides of the Container Storage Area for potential parking of fork lift trucks and emergency response vehicles, and storage of scrap metal containers. No historical soil sampling or analytical results are available for this area.

The PR/VSI identified evidence of soil contamination (discolored soils) adjacent to the concrete pad at the Container Storage Area. The PR/VSI further stated that the potential for release of contaminants to adjacent soil from this unit was moderate to high.

B. SWMU #3 INVESTIGATION SUMMARY

On December 2 and 7, 1998, CRA supervised the installation of six investigative boreholes in the vicinity of SWMU #3 (Figure 4.1). Four of the six boreholes (BH-3-1 through BH-3-4) were completed on the south, west, north, and east sides of the Container Storage Area, respectively. The two remaining boreholes (BH-3-5 and BH-3-5A) were completed in the center of the Container Storage Area. All boreholes were advanced to approximately 20 feet below grade, except BH-3-5 (16.6 feet). Borehole BH-3-5 was terminated at 16.6 feet due to auger refusal. It was replaced by borehole BH-3-5A, which was completed approximately seven feet south of BH-3-5. After completing the sampling activities, all borings were abandoned with bentonite chips and capped with at least six-inches of concrete. The concrete cap for the two borings completed within the storage pad were sealed with a chemically resistant coating (an epoxy resin).

Ten soil samples collected from SWMU #3 were submitted for laboratory analysis. These included two samples from each borehole except BH-3-5A, which did not have any samples submitted for chemical analysis. Two samples were submitted from the adjacent borehole BH-3-5, where the PID field screening results were higher than those recorded for borehole BH-3-5A. The soil samples selected for chemical analysis were generally collected from near surface intervals (between 0.5 and 3.0 feet below grade) and shallow subsurface intervals (between 3.0 and 9.0 feet below grade) using the criteria specified in the RFI Work Plan. Nine of the ten soil samples submitted to the laboratory were analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, TAL metals, and total cyanide. The tenth sample (BH-3-4, 3 to 5 feet bgs), was analyzed for the Appendix IX constituents (VOCs, SVOCs, PCBs, metals, cyanide, and sulfide).

4.1.2 SWMU #29 - WASTEWATER TREATMENT TANK AREA

A. SWMU #29 DESCRIPTION

The Wastewater Treatment Tank Area is located east of Building 56 and west of Centerpoint Parkway in the southcentral portion of the Facility (Figure 4.2). Currently, the area consists of 20 open top, vertical, above-ground storage tanks (ASTs). These tanks have been periodically painted over the years and tested for structural integrity. The wastewater treatment tank area has a total capacity of approximately 7.85 million gallons of water. Of this, 5.85 million gallons are used for treatment. The remaining 2.0 million gallons are used for clarification. The wastewater treatment tanks are designated as follows:

# of Tanks	*Description*	*Working Volume (gallons)*
3	Treatment of Acid Wastes	343,000
6	Treatment of General Wastes	716,000
2	Clarifiers	827,000
1	Equalization Tank	349,000
3	Sludge Thickening Tanks	36,000
1	Cleaner Waste Tank	177,000
3	Oil Skimmer Tanks	5,000

The PR/VSI report indicated that the wastewater treatment tank area had a history of releasing acidic/oily wastes to adjacent soils. Visible signs of release were noted during the 1987 Facility inspection.

B. SWMU #29 INVESTIGATION SUMMARY

On December 1 and 2, 1998, CRA supervised the installation of eight investigative boreholes in the vicinity of SWMU #29 (see Figure 4.2). Four of the boreholes (BH-29-1 through BH-29-4) were completed on the southwest, south, east, and north perimeter of the tank area, respectively. The other four boreholes (SS-29-1 through SS-29-4) were completed north of General Waste Treatment Tank #6, northeast of Waste Holding Tank #3, northwest of Clarifier #2, and southeast of General Waste Treatment Tank #2, respectively. Boreholes for BH-29-1 through BH-29-4 were advanced to 20 feet below grade and boreholes SS-29-1 through SS-29-4 were advanced to 2.0 feet below grade.

Nine soil samples collected from SWMU #29 were submitted for laboratory analysis. This included one soil sample from each of the eight sampling locations plus a duplicate sample from borehole SS-29-4. The surficial soil samples collected from the shallow boreholes (designated with an "SS") were collected between 0.8 and 2.0 feet below grade. The soil samples collected from the deeper boreholes (designated with a "BH") were collected between 4 and 6 feet below grade or 10 and 12 feet below grade. Eight of the nine soil samples submitted to the laboratory were analyzed for TCL VOCs, TCL

SVOCs, TCL PCBs, TAL metals, and cyanide. The ninth sample (SS-29-1, 0.8 to 2.0 feet), was analyzed for the Appendix IX constituents (VOCs, SVOCs, PCBs, metals, cyanide, and sulfide). During the soil sampling activities, a split-spoon rinsate sample was also collected. The rinsate sample was analyzed for TCL VOCs, SVOCs, PCBs, and TAL metals.

4.1.3 SWMU #31 - FORMER SURFACE IMPOUNDMENT

A. SWMU #31 DESCRIPTION

The Former Surface Impoundment was located on the south side of the wastewater treatment tank area in the south central portion of the Facility. It was used to temporarily store wastewater during a period of repair to the WWTP. Since 1995, redevelopment activities in the vicinity of the Former Surface Impoundment have included the construction of the South Access Road, and grading and landscaping during development of the Centerpoint Business Campus. Although the exact boundaries of the impoundment are unknown, its approximate location is presented on Figure 4.3. The location was identified and staked in the field through the use of historical topographic maps, benchmarks, aerial photographs, and existing surveys available for this portion of the Facility.

The PR/VSI report indicated that the former surface impoundment was used to store approximately 70,000 gallons of F006/F019 wastes, which may have contained heavy metals. GM indicated that the storage occurred on a temporary basis once in 1978 during an upset in their wastewater treatment plant process operations. The PR/VSI also indicated that the spill history in the area was unknown and noted that there were no release controls in place.

It should be noted that the approximate location of the Former Surface Impoundment is in the vicinity of the "Burn Pile". The Burn Pile area is discussed in further detail in the Review of Existing Conditions Report (CRA, 1995a) and Supplemental Review of Existing Conditions Report (CRA, 1995b).

B. SWMU #31 INVESTIGATION SUMMARY

On December 10 and 11, 1998, CRA supervised the installation of six investigative boreholes within and adjacent to SWMU #31 (see Figure 4.3). Two of the boreholes

(BH-31-1 and BH-31-3) were completed on the south and northeast sides of the former surface impoundment. The other four boreholes (BH-31-2 and SS-31-1 through SS-31-3) were completed in the central, southcentral, northwest, and northeast portions of the surface impoundment, respectively. Boreholes BH-31-1 through BH-31-3 were advanced to 20 feet below grade and boreholes SS-31-1 through SS-31-3 were advanced to 2.0 feet below grade.

Seven soil samples collected from SWMU #31 were submitted for laboratory analysis. This included one soil sample from each of the six sampling locations plus a duplicate sample from BH-31-1. The surficial samples were collected from 0.0 to 2.0 feet below grade. The soil samples selected for analysis from the deeper boreholes were collected from 4 to 6 feet below grade or 8 to 10 feet below grade. Six of the seven soil samples submitted to the laboratory were analyzed for TAL metals. The seventh sample (BH-31-2, 1.0 to 1.5 feet bgs) was analyzed for the Appendix IX constituents (VOCs, SVOCs, PCBs, metals, cyanide, and sulfide). Additionally, one of the six samples submitted for metals analysis (SS-31-2 , 0 to 2 feet) was also submitted for a TCL VOC analysis due to elevated PID readings. A split-spoon rinsate sample was also collected after the soil sampling activities were completed. The rinsate sample was analyzed for TCL VOCs and TAL metals.

4.1.4 SWMU #33 - FORMER SOUTH RETENTION POND

A. SWMU #33 DESCRIPTION

The Former South Retention Pond was located in the southeastern portion of the Facility, east of the Grand Trunk Western Railway, north of Square Lake Road, and west of Opdyke Road (see Figure 4.4). The Former South Retention Pond, which was approximately 100 yards long, 5 to 7 yards deep, and 30 yards wide, collected storm water runoff from the south end of the Pontiac East Assembly Plant and the wastewater treatment plant area. As part of the Site redevelopment program, the south retention pond was backfilled, redeveloped for commercial uses, and leased to the existing developer of the Centerpoint Business Campus. The Centerpoint Parkway roadway has also been constructed immediately north and west of the Former South Retention Pond and provides primary access within the Centerpoint Business Campus.

The PR/VSI report indicated that potential contaminant-laden runoff from the retention pond collection areas may have contributed to a release of hazardous constituents to soils in area. The pond was regulated under NPDES storm water discharge permit No. MI0001007.

B. SWMU #33 INVESTIGATION SUMMARY

On December 9, 11, and 16 through 18, 1998, CRA supervised the installation of seven investigative boreholes in the vicinity of SWMU #33 (see Figure 4.4). The seven boreholes (BH-33-1 through BH-33-7, and BH-33-3A) were completed adjacent to and within the estimated boundary of former retention pond. The approximate boundaries were identified and staked in the field through the use of historical topographic maps, benchmarks, aerial photographs and existing topographic plans, and surveys available for this portion of the Facility. The boreholes were advanced to depths of 34 feet, 36 feet, 28 feet, 31.5 feet, 42 feet, 40 feet, and 40 feet, respectively. Boreholes BH-33-3 and BH-33-4 were terminated at 28 feet and 31.5 feet below grade after encountering obstructions. Borehole BH-33-3A, which was installed as a replacement boring for BH-33-3, was installed approximately 8 feet northwest of borehole BH-33-3. It was extended to 40 feet below grade with continuous soil sampling employed between 28 and 40 feet below grade. Although the RFI Work Plan stated that boreholes at SWMU #33 were to be advanced approximately 20 feet below grade, the boreholes were extended to approximately 40 feet below due to the fill material imported to the area.

Twelve soil samples collected from SWMU #33 were submitted for laboratory analysis. This included at least one soil sample from each of the six sampling locations. Additionally, a second soil sample was submitted from boreholes BH-33-1, BH-33-2, BH-33-3, and BH-33-4 and duplicate samples were submitted from BH-33-1 and BH-33-4. The soil samples selected for analysis were collected between 14 and 36 feet below grade. Nine of the twelve soil samples submitted to the laboratory were analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, TAL metals, and cyanide. The remaining three soil samples from BH-33-1 and BH-33-4 and a duplicate sample from BH-33-1, were analyzed for the Appendix IX constituents (VOCs, SVOCs, PCBs, metals, cyanide, and sulfide). During the soil sampling activities, a split-spoon rinsate sample was also collected. The rinsate sample was analyzed for TCL VOCs , SVOCs, PCBs, and TAL metals.

4.1.5 SWMU #34 - NORTH RETENTION POND

A. SWMU #34 DESCRIPTION

The North Retention Pond is located in the north central portion of the Facility, south of South Boulevard and north of Campus Drive (see Figure 4.5). The North Retention Pond, which was originally approximately 30 yards long, 3 yards deep, and 15 yards wide, historically collected storm water runoff from the northern parking lots of the Pontiac East Assembly Plant. As part of the Site redevelopment program, the North Retention Pond was regraded, deepened and landscaped to accommodate additional stormwater runoff from the newly constructed GM TPC East parking lots and Campus Drive. The North Retention Pond and surrounding property has been leased to the existing developer of the Centerpoint Business Campus.

The PR/VSI report indicated that potential contaminant-laden runoff from the North Retention Pond collection area may have contributed to a release of hazardous constituents to soils in the area.

B. SWMU #34 INVESTIGATION SUMMARY

On December 3, 4, and 8, 1998, CRA supervised the installation of four investigative boreholes and the collection of two sediment samples within and adjacent to the North Retention Pond (Figure 4.5). The four boreholes (BH-34-1 through BH-34-4) were completed within the southeast, southwest, northwest, and northeast portions of the pond, respectively. All boreholes were advanced to 20 feet below grade. The two sediment samples (SD-34-1 and SD-34-2) were collected within the center portion of the existing retention pond. The sediment sampling locations were terminated approximately one foot below grade.

Five soil samples and two sediment samples collected from SWMU #34 were submitted for laboratory analysis. This included one soil sample from each location plus a duplicate sample from BH-34-1. The soil samples from the boreholes were collected from 2.0 to 4.0 feet below grade. The sediment samples were collected between 0.0 and 1.0 foot below grade. Six of the seven soil samples submitted to the laboratory were analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, TAL metals, and cyanide. The seventh sample (SD-34-2), was analyzed for the Appendix IX constituents (VOCs, SVOCs, PCBs, metals, cyanide, and sulfide).

4.2 PHASE II RFI FIELD INVESTIGATION: PERCHED WATER TABLE ZONE

The second phase of RFI field activities was conducted between August 9 and 17, 2000. One monitoring well (MW-3-1) was installed at SWMU #3 in the vicinity of BH-3-1, where a native sand seam had been encountered from 11 to 14 feet bgs during the Phase I RFI field investigation (Figure 4.1). The second monitoring well (MW-31-1) was installed at SWMU #31 in the vicinity of BH-31-2, where a native sand seam had been encountered during the Phase I RFI field investigation from 9 to 12 feet bgs (Figure 4.3). All monitoring well installation protocols were consistent with the Field Sampling Plan (Appendix G of the approved RFI Work Plan (CRA, 1998b)). Stratigraphic and Instrumentation logs for the two perched water table zone monitoring wells are presented in Appendix A.

Groundwater samples were collected and analyzed in accordance with the approved Quality Assurance Project Plan (QAPP) (CRA, 1998b)) (Appendix C of the RFI Work Plan (CRA, 1998b)) and the RFI Work Plan Addendum dated July 27, 2000. Development and purging of the monitoring wells was completed with a variable speed peristaltic pump (to minimize agitation) and samples were collected with disposable polyethylene bailers. Field parameters of pH, temperature, and conductivity were measured, and the samples were collected in order of the parameters' volatilization sensitivity (i.e., most volatile first). Groundwater samples were analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, and TAL metals.

5.0 RESULTS OF RFI

The RFI results are presented in a manner consistent with the two phases of the RFI investigation:

- Phase I RFI Results: Soil; and
- Phase II RFI Results: Perched Water Table Zone.

The results are discussed in the following sections.

5.1 PHASE I RFI RESULTS: SOIL

This section of the RFI Report presents a geological and soil sample analytical summary for each of the five SWMUs investigated during the RFI. Stratigraphic and instrumentation logs are presented in Appendix A. Laboratory analytical data reports are presented in Appendix B. Data validation reports are presented in Appendix D.

5.1.1 SWMU #3 - CONTAINER STORAGE AREA

The general geologic conditions encountered at the Container Storage Area consisted of approximately 0.5 to 1.0 feet of concrete followed by 0.3 to 6.3 feet of a medium-grained sand fill material. Underlying the fill material was an olive to dark gray silty clay (till). As presented in geologic cross sections A-A' and B-B' (Figures 5.1 and 5.2), several moist to wet discontinuous sand lenses of variable thickness (1 to 5 feet) were encountered within the silty clay at depths ranging from approximately 6 to 11 feet below grade (915.6 to 922.0 feet AMSL). The uppermost sand lens was encountered approximately 6 to 8 feet below grade and the second sand lens was encountered approximately 10 to 12 feet below grade. The thickness of the uppermost sand lens ranged between 0.8 and 5.2 feet and appeared to pinch out completely on the south side of SWMU #3 at borehole BH-3-1 (see Figure 5.2). The thickness of the second sand lens ranged between approximately 0.8 and 3.1 feet and appeared limited to the southeast corner of the containment pad as it was only identified at boreholes BH-3-1 and BH-3-4. No visual staining was observed during the sampling activities.

Since the geologic conditions encountered did not meet the monitoring well screening requirements specified in the RFI Work Plan (i.e., greater than five feet of native sand with greater than 2 feet of saturated thickness), no monitoring wells were set below SWMU #3.

Analytical results for the soil samples collected from the Container Storage Area identified no VOCs, 20 SVOCs, one PCB, 23 metals and total cyanide at concentrations at or above the laboratory method detection limit. A summary of the analytes detected at SWMU #3 is presented below and in Tables 5.1, 5.2, and 5.3. Table 5.1 presents the TCL/TAL analyses. Table 5.2 presents the Appendix IX analyses. Table 5.3 presents a summary of the Tentatively Identified Compounds (TICs) analyses. The highest concentration or highest estimated concentration (denoted with a "J" qualifier), of each analyte detected in the area, in milligrams per kilogram (mg/kg), is listed in parenthesis below (except for the metals). The majority of these concentrations were detected in the fill material encountered at borehole BH-3-4 (1 to 3 feet below grade).

- The 20 SVOCs detected include 2-methylnaphthalene (0.3 mg/kg), acenaphthene (1.5 mg/kg), anthracene (2.6 mg/kg), benzo(a)anthracene (3.2 mg/kg), benzo(a)pyrene (2.6 mg/kg), benzo(b)fluoranthene (3.3 mg/kg), benzo(g,h,i)perylene (1.2 mg/kg), benzo(k)fluoranthene (1.4 mg/kg), bis (2-ethylhexyl)phthalate (0.1J mg/kg), carbazole (1.6 mg/kg), chrysene (2.9 mg/kg), dibenzo(a,h)anthracene (0.4 mg/kg), dibenzofuran (1.2 mg/kg), fluoranthene (9.7 mg/kg), fluorene (1.8 mg/kg), indeno(1,2,3-cd)pyrene (1.4 mg/kg), naphthalene (0.8 mg/kg), phenanthrene (12.0 mg/kg), phenol (0.4 mg/kg), and pyrene (8.3 mg/kg);
- The only PCB compound detected was Aroclor 1254 (0.13J mg/kg); and
- All 23 TAL metals were detected (see Tables 5.1 and 5.2 for individual metal concentrations detected in the samples).

As presented in Tables 5.1, 5.2, and 5.3, none of the analyte concentrations detected at the Container Storage Area were above the applicable June 2000 MDEQ generic industrial cleanup criteria which were utilized as the screening levels.

5.1.2 SWMU #29 - WASTEWATER TREATMENT TANK AREA

The general geologic conditions encountered in the Wastewater Treatment Tank Area consisted of approximately zero to 4.3 feet of sand or gravel fill material overlying a brown to dark brown to olive green silty clay (till). A moist to wet sand lens of variable thickness (0.6 to 2.7 feet) was encountered within the clay till in three of the four boreholes at depths ranging from approximately 11 to 12.6 feet below grade (940.5 to 945.3 feet AMSL). As presented on geologic cross sections C-C' and D-D' (Figures 5.3 and 5.4), the thickness of the sand lens appeared to range between 0.6 and 2.7 feet. It also appeared to be pinch out completely on the northern side of the Wastewater Treatment Area at borehole BH-29-4 (Figure 5.4). No visual staining was observed during the sampling activities.

Additionally, since the geologic conditions encountered did not meet the monitoring well screening requirements specified in the RFI Work Plan (i.e., greater than five feet of native sand and greater than 2 feet of saturated thickness), no monitoring wells were set below the SWMU #29 area.

Analytical results for the soil samples identified five VOCs, 17 SVOCs, two PCBs, 23 metals and sulfide at concentrations at or above the laboratory method detection limit. A summary of the analytes detected at SWMU #29 is presented below and in Tables 5.4, 5.5, and 5.6. The highest concentration, or highest estimated concentration (denoted with a "J" qualifier), for each analyte detected in the area is listed in parenthesis below (except for the metals). The majority of the organic constituents were detected in the fill material encountered at borehole SS-29-2 (0.8 to 2.0 feet below grade) or BH-29-2 (4 to 6 feet below grade).

- The five VOCs detected include ethylbenzene (0.12 mg/kg), m,p-xylene (0.63 mg/kg), o-xylene (0.22 mg/kg), tetrachloroethene (0.04J mg/kg), and toluene (0.043J mg/kg);
- The 17 SVOCs detected include acenaphthene (0.6 mg/kg), anthracene (0.5 mg/kg), benzo(a)anthracene (1.1 mg/kg), benzo(a)pyrene (1.0 mg/kg), benzo(b)fluoranthene (1.0 mg/kg), benzo(g,h,i)perylene (0.5 mg/kg), benzo(k)fluoranthene (0.8 mg/kg), carbazole (0.2J mg/kg), chrysene (1.2 mg/kg) dibenzo(a,h)anthracene (0.2J mg/kg), dibenzofuran (0.8 mg/kg), fluoranthene (1.8 mg/kg), fluorene (0.5 mg/kg), indeno(1,2,3-cd)pyrene (0.6 mg/kg), naphthalene (0.1J mg/kg), phenanthrene (1.7 mg/kg), and pyrene (2.0 mg/kg);
- The two PCB compounds detected were Aroclor 1254 (0.56J mg/kg) and Aroclor 1260 (0.10J mg/kg); and
- All 23 TAL metals were detected (see Table 5.4 and 5.5 for individual metal concentrations detected in the samples).

As presented in Tables 5.4, 5.5, and 5.6, none of the analyte concentrations detected at the Waste Water Treatment Tank Area were above the applicable June 2000 MDEQ generic industrial cleanup criteria which were utilized as the screening levels.

5.1.3 SWMU #31 - FORMER SURFACE IMPOUNDMENT

The general geologic conditions encountered in the Former Surface Impoundment area consisted of approximately 3.5 to 9.0 feet of clay fill material overlying a medium to dark gray silty clay (till). An odorless, black staining was observed within the fill material between 1.0 and 1.9 feet below grade in borehole BH-31-2 and between approximately 4.5 and 6.0 feet below grade in the clay fill in borehole BH-31-3. As presented in geologic cross section E-E' (Figure 5.5), a thin discontinuous sand lens was encountered within the native silty clay approximately 8 to 10 feet below grade (933 to 931 feet AMSL). The thickness of the sand lens appeared to range between 2.0 and 3.5 feet and appeared to pinch out completely on the eastern side of the study area at borehole BH-31-1 (Figure 5.5).

Since the geologic conditions encountered did not meet the monitoring well screening requirements specified in the RFI Work Plan (i.e., greater than five feet of native sand and greater than 2 feet of saturated thickness), no monitoring wells were set within the SWMU #31 area at the time of the Phase I Investigation.

Analytical results for the soil samples identified one VOC, 11 SVOCs, one PCB, 23 metals and total cyanide at concentrations at or above the laboratory method detection limit. A summary of the analytes detected in the area is presented below and in Tables 5.7, 5.8, and 5.9. The highest concentration, or highest estimated concentration (denoted with a "J" qualifier), for each analyte detected in the area is listed in parenthesis below (except for the metals). The majority of the organic constituents were detected in the fill material encountered at borehole BH-31-2 (1.0 to 1.5 feet below grade).

- The only VOC detected was acetone (11 mg/kg);
- The 11 SVOCs detected include 4-chloroaniline (0.3 mg/kg), acenaphthene (0.7J mg/kg), anthracene (0.6J mg/kg), bis(2-ethylhexyl)phthalate (4.3 mg/kg), butyl benzl phthalate (0.2J mg/kg), di-n-butyl phthalate (0.5J mg/kg), dibenzofuran (0.1J mg/kg), fluoranthene (0.2J mg/kg), naphthalene (0.5 mg/kg), phenanthrene (0.3 mg/kg), and pyrene (0.3J mg/kg);
- The only PCB compound detected was Aroclor 1254 (0.1J mg/kg); and

- All 23 TAL metals were detected (see Tables 5.7 and 5.8 for individual metal concentrations detected in the samples).

Of the analytes detected, only two of the metal concentrations (arsenic and lead) exceeded any of the applicable June 2000 MDEQ generic industrial cleanup criteria screening levels. The arsenic concentrations detected in BH-31-3, 4 to 6 feet (140 mg/kg) and BH-31-2, 1.0 to 1.5 feet (117 mg/kg) were both above the MDEQ DCC of 61 mg/kg. The lead concentrations detected in BH-31-3, 4 to 6 feet (2,780 mg/kg) and BH-31-2, 1.0 to 1.5 feet (1,790 mg/kg), were both above the MDEQ generic industrial cleanup criteria screening level of 900 mg/kg.

5.1.4 SWMU #33 - FORMER SOUTH RETENTION POND

The general geologic conditions encountered in the Former South Retention Pond consisted of approximately 15 to 20 feet of clay fill material overlying a medium to dark gray silty clay (till). A gray to brown silt horizon was typically detected between 22 and 28 feet below grade. The single exception was borehole BH-33-5, which encountered a fine to course sand at 40 feet below grade. Otherwise, as presented on geologic cross section F-F' (Figure 5.6), the subsurface geology at the Former South Retention Pond (SWMU #33) did not appear to contain any sand lenses. No odors or staining was observed during the sampling activities.

Since the geologic conditions encountered did not meet the monitoring well screening requirements specified in the RFI Work Plan (i.e., greater than five feet of native sand and greater than 2 feet of saturated thickness), no monitoring wells were set within the SWMU #33 area.

Analytical results for the soil samples identified no VOCs, two SVOCs (2-methylnaphthalene and phenanthene), no PCBs, and 23 metals at concentrations at or above the laboratory method detection limit. Analytical results are presented in Tables 5.10, 5.11 and 5.12.

As presented in Tables 5.10 and 5.11, none of the analyte concentrations at the Former South Retention Pond were above the applicable June 2000 MDEQ generic industrial cleanup criteria screening levels.

5.1.5 SWMU #34 - NORTH RETENTION POND

The general geologic conditions encountered in the North Retention Pond area consisted of approximately 1.5 to 3.8 feet of sand and/or clay fill material overlying a brown to dark brown, gray or dark gray silty clay (till) which was encountered between 3.6 and 8.4 feet below grade and continued throughout the total depth of each boring. Thin laterally discontinuous sand seams (less the 0.4 feet thick) were occasionally identified within the gray clay. As presented on geologic cross section G-G' (Figure 5.7), the subsurface geology at the North Retention Pond (SWMU #34) did not appear to contain any significant sand lenses. No visual staining was observed during the sampling activities.

Since the geologic conditions encountered did not meet the monitoring well screening requirements specified in the RFI Work Plan (i.e., greater than five feet of native sand and greater than 2 feet of saturated thickness), no monitoring wells were set within the SWMU #34 area.

Analytical results for the soil samples identified no VOCs, 20 SVOCs, no PCBs, and 23 metals at concentrations at or above the laboratory method detection limit. A summary of the analytes detected in the area is presented below and in Tables 5.13, 5.14, and 5.15. The highest concentration or highest estimated concentration (denoted with a "J" qualifier), of each analyte detected in the SWMU #34 area is listed in parenthesis below (except for the metals). The majority of the organic constituents were detected in the fill material encountered in sediment sample SD-34-1 (0 to 1 foot below grade).

- The 20 SVOCs detected include 2-methylnapthalene (0.2 mg/kg), acenaphthene (1.9 mg/kg), anthracene (4.5 mg/kg), benzo(a)anthracene (12 mg/kg), benzo(a)pyrene (12 mg/kg), benzo(b)fluoranthene (13 mg/kg), benzo(g,h,i)perylene (4.2 mg/kg), benzo(k)fluoranthene (11 mg/kg), bis (2-ethylhexyl)phthalate (4.1J mg/kg), carbazole (2.9 mg/kg), chrysene (14 mg/kg), di-n-octyl phthalate (0.1J mg/kg), dibenzo(a,h)anthracene (1.4 mg/kg), dibenzofuran (1.3 mg/kg), fluoranthene (33 mg/kg), fluorene (2.8 mg/kg), indeno(1,2,3-cd)pyrene (7 mg/kg), naphthalene (0.3 mg/kg), phenanthrene (26 mg/kg), and phenol (28 mg/kg); and
- All 23 TCL metals were detected (see Table 5.13 and 5.14 for individual metal concentrations detected in the samples).

As presented in Tables 5.13, 5.14, and 5.15, none of the analyte concentrations at the North Retention Pond were above the applicable June 2000 MDEQ generic industrial cleanup criteria screening levels.

5.2 PHASE II RFI RESULTS: PERCHED WATER TABLE ZONE

The Phase II investigative work identified 3 VOCs, no SVOCs, no PCBs, 16 total metals, and 14 dissolved metals at concentrations at or above the laboratory method detection limit. All three of the organic constituents (benzene, cis-1,2-Dichloroethene, and vinyl chloride) were detected in the groundwater sample collected from MW31-1. No organic constituents were detected in the two groundwater samples collected from MW3-1. A summary of the detected analyte results is presented in Table 5.16.

Exceedances of the Michigan Public Act 451, Part 201 Industrial/Commercial Drinking Water Criteria and Federal Maximum Contaminant Levels (MCLs) are underlined in Table 5.16. All TCL VOCs and TAL total and dissolved metals were below the Michigan Public Act 451, Part 201 Industrial Groundwater Contact Criteria (GCC) for all groundwater samples. All of the perched groundwater samples were non-detect for TCL SVOC and TCL PCB analytes.

Analytical data report summaries are presented in Appendix B. The laboratory assessment and validation reports are presented in Appendix D.

5.3 SUMMARY OF RFI RESULTS

5.3.1 SOIL

Validated soil analytical data were compared to the applicable MDEQ risk-based standards which were utilized as screening levels for the RFI as detailed in Section 2.6.

Several criteria were eliminated from consideration including GSI and DWP criteria. The GSI criteria was eliminated based on the absence of surface water bodies on or adjacent to the Facility. The DWP criteria were eliminated based on MDPH regulations and previous geologic characterization at the Site. The MDPH regulations (Part 127 of Act 368) prohibit drinking water wells at a depth of less than 25 feet, which would exclude the limited water that may be present within the surficial fill material or within the thin, shallow, discontinuous sand lenses as a source of drinking water.

Additionally, the potable drinking water encountered approximately 120 feet below grade is protected by approximately 100 feet of clay-rich glacial till. This glacial till has an estimated hydraulic conductivity of 10^{-7} cm/sec and acts as an aquitard, restricting vertical movement and/or migration.

Based on an evaluation of the applicable MDEQ generic industrial cleanup criteria, the generic industrial DCC is generally the most stringent for the conditions identified at the Facility. Therefore, although all the criteria listed above were compared to the analytical results from the RFI, only the DCC criteria are listed as screening levels in the data tables to compare, assess, and identify potential risks associated with the chemical constituents detected during the investigation. As indicated above, the DCC and other applicable criteria are summarized in MDEQ Operational Memorandum No. 18, which is presented in Appendix D.

A comprehensive summary of the organic and inorganic analytes detected at each SWMU, their reported concentrations, and the MDEQ industrial DCC screening levels for soil is presented in Tables 5.1 through 5.15. In addition, the detection frequencies, the range of detections, the calculated mean and the 95 percent upper confidence level (95% UCL) of the mean concentrations are summarized in Tables 5.17 through 5.21 for all reported analytes, for each SWMU. To calculate the 95% UCL concentration for reported analytes, soil analytical data were tested for normality using the Shapiro-Wilks test. For a normally distributed data set, the 95% UCL was calculated following the equation outlined below:

$$95\%\ \text{UCL} = \frac{x + t \bullet S}{\sqrt{n}}$$

where:

95% UCL	=	upper confidence limit of the mean;
x	=	mean of the untransformed data;
t	=	student t-statistic;
S	=	standard deviation of the untransformed data; and
n	=	number of samples.

For a lognormally distributed data set, the 95% UCL was calculated following the equation outlined below:

$$95\%\ UCL = e^{\left(x + 0.5s^2 + sH/\sqrt{n-1}\right)}$$

where:

95% UCL	=	upper confidence limit of the mean;
e	=	constant (base of the natural log, equal to 2.718);
x	=	mean of the transformed data;
s	=	standard deviation of the transformed data;
H	=	H-statistic (e.g., from table published in Gilbert, 1987); and
n	=	number of samples.

The result of the screening level assessment indicates that all analytes detected from SWMUs #3, #29, #33, and #34 were below the applicable MDEQ generic industrial criteria screening levels. The only exceedance of the screening levels include two detections of arsenic and two detections of lead at SWMU #31. The arsenic concentrations detected in BH-31-3, 4 to 6 feet (140 mg/kg), and BH-31-2, 1.0 to 1.5 feet (117 mg/kg), were both slightly above the MDEQ DCC screening level of 61 mg/kg. It should be noted that the mean concentration of arsenic at SWMU #31 was 52.5 mg/kg, which is significantly lower than the screening level of 61 mg/kg. In addition, the 95% UCL only slightly exceeded the screening level of 100 mg/kg at 101.8 mg/kg.

The lead concentrations detected in BH-31-3, 4 to 6 feet (2,780 mg/kg), and BH-31-2, 1.0 to 1.5 feet (1,790 mg/kg), were both above the MDEQ DCC screening level of 900 mg/kg. The mean and 95% UCL level for lead at SWMU #31 were 945.3 mg/kg and 1864.0 mg/kg, respectively.

Based upon a review of the results against the appropriate screening levels, no additional evaluation is required to assess potential risks at SWMU #3, #29, #33, and #34. The analytical results at SWMU #31 indicate exceedances of the industrial based screening levels for arsenic and lead. Consequently, additional evaluation, in the form of a preliminary risk evaluation (PRE), is warranted at SWMU #31. The PRE related to arsenic and lead in soil for SWMU #31 is presented in Section 6.0.

5.3.2 PERCHED WATER TABLE ZONE

All perched groundwater results were either non-detect (TCL SVOC and TCL PCB) or below Michigan Public Act 451, Part 201 GCC. Perched groundwater results are presented in Table 5.16.

6.0 PRELIMINARY RISK EVALUATION AT SWMU #31

A PRE was undertaken to further assess the potential risk to human health posed by arsenic and lead in soils at SWMU #31. Perched water table issues were not identified at SWMU #31.

As discussed in Section 2.6, validated soil analytical data from SWMU #31 were compared to the generic risk-based industrial cleanup criteria screening levels specified in the MDEQ ERD Operational Memorandum No. 18, revised June 6, 2000 (MDEQ, 1999). Comparison of the SWMU-specific data to the MDEQ risk-based industrial criteria screening levels identified arsenic and lead as chemicals of potential concern (COPC) (see Table 5.19).

6.1 EXPOSURE ASSESSMENT

The area on which SWMU#31 is located is currently zoned and used for industrial purposes (see Figure 2.1). In addition, it is expected that the current land use of SWMU #31 will remain unchanged in the reasonably foreseeable future. It should be noted, however, that no further development or construction activities are currently planned for this area. The physical setting of SWMU #31 is discussed in Section 4.3.1 of this Report and summarized below.

A secured access road exists through the area of SWMU#31 (see Figure 6.1). This access road is a paved road for limited use by employees only to travel to and from the wastewater treatment plant (from the Pontiac East Assembly Plant). There are no sidewalks or decorative landscaping, or known subsurface utilities in the immediate vicinity of SWMU#31. No industrial work activities occur in the vicinity of SWMU #31. Moreover, access to the road is secured by a guardhouse near the Facility truck docks at the rear of the Pontiac East Assembly thereby further limiting access to trespassers, construction workers, or industrial employees. Photographs of the SWMU#31 area, in its present conditions, are presented on Figure 6.1.

Based on SWMU-specific information, the potential receptors subject to the highest frequency of exposure to the arsenic and lead concentrations above the generic MDEQ DCC screening levels are construction workers involved in some form of future soil excavation activities. Exposures to trespassers (considered to be of extremely low frequency due to existing security measures) and industrial workers (or landscapers) are expected to be mitigated by the presence of asphalt and topsoil/grass over the area of

SWMU #31 (see Figure 6.1). Potential exposure to soils could occur if Facility activities require excavation of surface and subsurface soils, as could be the case during future construction activities at the Facility. During the construction, the soils could be disturbed and construction workers could be exposed to impacted surficial and subsurface soils.

6.1.1 EXPOSURE POINT CONCENTRATIONS

For this SWMU #31 PRE, a most likely exposure scenario (Mean) and a reasonable maximum exposure (RME) scenario were evaluated to estimate a range of potential risks. U.S. EPA has defined the RME concentration as the 95 percent upper confidence limit (95% UCL) of the mean of concentrations, and the mean or average concentration as appropriate for the most likely exposure scenario (Mean) ("Supplemental Guidance to RAGS: Calculating the Concentration Term", OSWER Publication 9285.7-081, May 1992). For this evaluation, the average concentration was calculated by averaging results for all samples using the detected concentrations and counting all non-detects (NDs) as half the detection limit for constituents which were reported as both positive and non-detect in different samples from a single study area. In the event that duplicate samples were analyzed, the average concentration of the duplicate samples was used.

It is possible that soil excavation activities could occur at SWMU #31 in the future. In this case, subsurface soil could be disturbed and exposed. To evaluate SWMU #31 soil exposure scenarios under the future condition, all available soil data, regardless of depth, were used in calculating the mean and the 95% UCL concentrations for arsenic and lead. The arithmetic mean, the calculated 95% UCL, and maximum concentrations for arsenic and lead in SWMU #31 soils are summarized in Table 5.19.

6.1.2 QUANTIFICATION OF EXPOSURE

To evaluate the future construction worker exposure scenario, two levels of assumptions are presented. The Mean scenario presents the 50th percentile or average value for exposure factor assumptions approximating the average expected exposure conditions. The RME scenario presents the 95th percentile confidence level for exposure factor assumptions such as exposure duration, ingestion rates, and total exposed skin surface areas.

To quantify exposures, potential exposure scenarios were developed using exposure assumptions presented in the U.S. EPA documents entitled, "Risk Assessment Guidance for Superfund (RAGS)", Part I: Human Health Evaluation Manual, EPA/540/1-89/002, December 1989; "RAGS Supplemental Guidance Standard Default Exposure Factors", Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03, March 25, 1991; "RAGS Supplemental Guidance, Dermal Risk Assessment, Interim Guidance", March 14, 1999; and appropriate Michigan guidance and references. In some instances, where the U.S. EPA and Michigan guidance documents did not present necessary assumptions, and where specific appropriate exposure information were not available, professional judgment was applied to develop conservative assumptions which are protective of human health.

6.2 TOXICITY ASSESSMENT

Table 6.1 presents the toxicity factors [i.e., Cancer Slope Factor (CSF) and Reference Dose (RfD) values] used to estimate the potential non-carcinogenic hazard and incremental carcinogenic risk for arsenic.

A CSF is applied to estimate the potential risk of cancer from an exposure. A RfD is applied to estimate the potential for non-carcinogenic effects to occur from the exposure.

The CSF is expressed as $(mg/kg/day)^{-1}$ and when multiplied by the lifetime average daily dose expressed as mg/kg/day will provide an estimate of the probability that the dose will cause cancer during the lifetime of the exposed individual. This increased cancer risk is expressed by terms such as 1E-06 or 1×10^{-6}. This is a hypothetical estimate of the upper limit of risk based on very conservative or health-protective assumptions and statistical evaluations of data from animal experiments or from epidemiological studies. To state that a chemical exposure causes a 1E-06 added upper limit risk of cancer means that if 1,000,000 people are exposed, one additional incident of cancer is expected to occur. The calculations and assumptions yield an upper limit estimate which indicates that no more than one case is expected and, in fact, there may be no additional cases of cancer. Since U.S. EPA values for CSFs are 95% upper confidence levels, risks are 95% upper bound estimates. Thus, actual risks associated with exposure to a potential carcinogen are not likely to exceed the risks estimated using CSFs, but may be lower.

For substances suspected to cause noncarcinogenic chronic effects, the health criteria are usually expressed as chronic intake levels or RfDs (in units of mg/kg-day) below which no adverse effects are expected. In contrast with the underlying toxicological model used by U.S. EPA to assess carcinogenic risk, which assumes no threshold, the noncarcinogenic dose-response model postulates a "threshold." In other words, there is a level of exposure to a chemical below which virtually no effects are expected. In this PRE, chronic RfDs are used as the toxicity values for noncarcinogenic health effects.

6.3 RISK CHARACTERIZATION FOR ARSENIC

The results of the quantitative risk assessment for arsenic are presented in Appendix F, Tables F-1 to F-4, inclusive.

The estimated additional lifetime carcinogenic risks (R) were calculated according to the following general equation:

$$R = CDI * CSF$$

where:

R = Upper Bound Additional Lifetime Cancer Risks;
CDI = Lifetime Average Daily Dose (mg/kg-day); and
CSF = Cancer Slope Factor [$(mg/kg\text{-}day)^{-1}$].

The CSF represents the carcinogenic potency of a chemical. The dose, or intake, represents the amount of contaminant to which a receptor is exposed. When evaluating carcinogenic risks, the dose in all exposure scenarios is the estimated daily intake of each chemical, received during the specified period of exposure, and averaged over a 70-year lifetime.

U.S. EPA has not identified a single value that represents a significant incremental cancer risk. However, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) acceptable risk range for Superfund sites has been set at 10^{-6} to 10^{-4} per environmental medium (NCP, 1990). In other words, the goal of the NCP is to reduce the cancer risk associated with site contaminants in a given medium to within or below a range of 1 in 10,000 to 1 in 1,000,000.

Potential non-carcinogenic effects were evaluated based on a comparison of chemical-specific chronic exposure doses (depending on the scenario-specific exposure duration) with corresponding reference doses derived from health criteria (see Table 6.1). The result of this comparison is expressed as the Hazard Quotient (HQ):

$$HQ = \frac{\text{Exposure Dose}}{\text{Protective Dose}} = \frac{CDI}{RfD}$$

where:

HQ	=	Hazard Quotient;
CDI	=	Chronic Daily Intake (mg/kg-day); and
RfD	=	Reference Dose (mg/kg-day).

A HQ that exceeds unity (1.0) suggests a greater likelihood of developing an adverse chronic effect. However, the uncertainty factors built into the reference doses result in conservative protective dose values. Therefore, the reference dose is likely well below that for which adverse effects will be seen.

6.3.1 GENERAL SOILS (SURFACE AND SUBSURFACE SOILS) – FUTURE CONSTRUCTION WORKER EXPOSURE

A construction worker exposure scenario was developed assuming that soil excavation and/or construction will occur under the future Site condition. The scenario assumes that the construction worker will be involved in one excavation/construction project at the Facility for a period of 2 weeks (Mean) and 1 month (RME). It should be noted, however, that no further development or construction activities are currently planned for this area. The following conservative and health-protective assumptions were used to calculate exposures:

- Subsurface soils and surficial soils on the Site are disturbed/excavated.
- The exposure point concentrations for arsenic are the mean and the 95% UCL concentration or the maximum detected concentration, whichever is lower, for the Mean and RME condition, respectively.
- The inadvertent soil ingestion rate for adult workers is assumed to be 480 mg of soil per day for the Mean and RME (U.S. EPA, 1991).
- The exposed skin surface area includes the head, hands, and forearms yielding a total of 3,300 cm^2 for the Mean and RME (U.S. EPA, 1999).
- The soil-to-skin adherence factor is 0.02 mg/cm^2 for the Mean and 0.2 mg/cm^2 for the RME (U.S. EPA, 1999).
- The absorption efficiency applicable to ingestion is assumed to be 50 percent for arsenic (MDEQ, 1995).

- The absorption efficiency applicable to dermal contact is assumed to be 3 percent for arsenic (U.S. EPA, 1992).
- It is assumed that future soil excavation and/or construction will occur for no longer than a period of 2 weeks or 10 days for the Mean and, 1 month or 20 days for the RME.
- The adult worker is assumed to weigh 70 kg.
- Averaging time is 25,550 days or 70 years for carcinogens and ED*365 days for non-carcinogens.

The estimated cancer risks and hazards are summarized in Appendix F, Table F-1 to F-4, inclusive. The additional lifetime upper limit of cancer risks were estimated to be -1.07E-07 and -4.46E-07 for the Mean and RME, respectively. The hazard indices were below 1.0, the level of concern for both the Mean and RME. The estimated additional risks of cancer are well below the target U.S. EPA cancer risk range of 10^{-6} to 10^{-4}, while the non-carcinogenic hazards were below 1.0.

6.4 HUMAN HEALTH RISK EVALUATION FOR LEAD

6.4.1 QUANTITATIVE EVALUATION OF NON-RESIDENTIAL ADULT EXPOSURES TO LEAD

The best available quantitative tool for determining risks associated with non-residential adult exposures to lead-impacted soil is primarily based on the U.S. EPA report titled: "Recommendations of the Technical Review Workgroup (TRW) for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil" (dated December, 1996) and subsequent guidance present in the document titled "Frequently Asked Questions (FAQs) on the Adult Lead Model" (dated April 1999).

The derivation of risk-based remediation goals (RBRG) for lead in soil at any site is largely dependent on the present and expected future land use of the site. As in the arsenic evaluation, the potential exposures to lead-impacted soils by future construction workers were evaluated. Therefore, the soil RBRG for lead for the future construction worker is developed using the TRW Adult Exposure Equation Model.

6.4.1.1 ADULT EXPOSURE EQUATION

The TRW has indicated that the Adult Exposure Equation is a suitable and appropriate model for assessing adult exposures to lead in soils under an industrial setting. The Adult Exposure Equation recommended for use by the TRW is as follows:

$$RBRG = \frac{(PbB_{adult,\ central,\ goal} - PbB_{adult,0}) \bullet AT}{(BKSF \bullet IR_s \bullet AF_s \bullet EF_s)}$$

where:

RBRG	=	Risk-Based Remediation Goal for lead (ug/g);
$PbB_{adult,\ central,\ goal}$	=	goal for central estimate of blood lead concentration (µg/dL) in adults (i.e., women of childbearing age) that have site exposures. The goal is intended to ensure that $PbB_{95fetal}$ does not exceed 10 µg/dL;
$PbB_{adult,0}$	=	typical lead concentration (ug/g) (appropriate average concentration for individual);
AT	=	Averaging Time; the total period during which soil contact may occur; 365 days/year for continuing long term exposures;
BKSF	=	Biokinetic Slope Factor (µg/dL blood lead increase per µg/day lead uptake);
IR_S	=	Ingestion Rate of soil (g/day);
EF_S	=	Exposure Frequency for contact with assessed soils (days/yr); and
AF_S	=	absolute Absorption Fraction of lead in soil.

The basis for the RBRG calculation is the relationship between the soil lead concentration and the blood lead concentration in the developing fetus of adult women that have site exposures. The relationship between the blood lead concentration in adult women and the corresponding 95th percentile fetal blood lead concentration ($PbB_{95fetal}$), assuming that $PbB_{adult,\ central}$ reflects the geometric mean of a lognormal distribution of blood lead concentrations in women of child-bearing age, can be described by the following equation:

$$PbB_{adult,central,goal} = \frac{PbB_{95\,fetal}}{GSD_{i,adult}^{1.645} \bullet R_{fetal\,/\,maternal}}$$

where:

$PbB_{95fetal}$	=	95th percentile target blood lead (PbB) concentration in the fetus (μg/dL);
$R_{fetal/maternal}$	=	mean ratio of fetal to maternal PbB;
$GSD_{i,adult}$	=	individual Geometric Standard Deviation, an exponent of 1.645 represents the standard normal deviate used to calculate the 95^{th} percentile from a lognormal distribution of blood lead concentration.

6.4.1.2 ADULT EXPOSURE EQUATION INPUT PARAMETERS

The basis for selection of input parameters for the above model is discussed below.

- 95th Percentile Blood Lead (PbB) Concentration in the Fetus ($PbB_{95fetal}$ in μg/dL):

  U.S. EPA has also applied a value of 10 µg/dL as a target level that is protective for fetuses of pregnant women. Therefore, the value of 10 µg/dL was used in the modeling.

- Mean Ratio of Fetal to Maternal PbB ($R_{fetal/maternal}$):

  Various studies have estimated an average fetal-to-maternal PbB ratio of 0.9 based on a weight of evidence approach. This value has also been used by U.S. EPA in applying the Adult Exposure Model. Therefore, the value of 0.9 for was used in the modeling.

- Individual Geometric Standard Deviation ($GSD_{i,adult}$):

  This parameter is used to assess variability in blood lead concentrations among different individuals. Few data are available regarding GSD values reflecting individual variability. Instead, GSD values reflecting community variability (which would be expected to be greater than individual variability) are frequently applied to estimate individual variability. Various studies have indicated that community

GSDs may range from approximately 1.8 to 2.1. There are no Site-specific data of GSD values and therefore, it is assumed that the potentially exposed population is likely to be heterogeneous. A value for GSD of 2.0 was selected for use in this modeling to be consistent with U.S. EPA's most recent guidance. It should be noted that a GSD value of 2.0 is considered to be very conservative and a lower value (i.e., 1.8) is justified in minor circumstances.

- Baseline PbB Value ($PbB_{adult,0}$):

  This parameter is specific to the population in the area of interest. At this time, no source of data describing blood lead levels for the population in the vicinity of the Site has been identified. Therefore, published reference data were used to determine a representative value. A value of 2.0 µg/dL was chosen for this input parameter based on the assumption of a mixed racial worker population.

- Biokinetic Slope Factor (BKSF in µg/dL per µg/day):

  The TRW adopted a BKSF of 0.4, derived for the baseline human health risk assessment for the California Gulch Superfund Site. Therefore, the default value of 0.4 for the parameter BKSF was used in the modeling.

- Soil Absolute Absorption Fraction of Lead (AF_s):

  The TRW uses 12 percent (12%) as the absorbed fraction of lead from soil and dust for adults, based on an absorption factor for soluble lead of 0.20 and a relative bioavailability of 0.6 (soil/soluble).

- Soil Ingestion Rate (IRs in g/day):

  An ingestion rate of 0.10 g/day was applied for a construction worker at the Site.

6.4.2 SUMMARY

Using the input parameters for the future construction worker, the derived soil RBRG for lead is 5,904 mg/kg. The result of the lead modeling is presented in Table 6.2. The concentrations of lead detected at SWMU#31 are well below the calculated RBRG (which is considered to be a protective level by U.S. EPA).

7.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

CRA conducted an RFI at the GM Truck Group Facility in Pontiac, Michigan in two phases between November 1998 and January 1999 (Phase I), and August 2000 (Phase II) (Figure 1.1). The investigative activities focused on five SWMUs identified by the U.S. EPA in a Consent Order that required GM to initiate investigative/corrective actions at the Facility. The RFI investigation was completed in accordance with the general specifications outlined in a U.S. EPA-approved RFI Work Plan (CRA, 1998b) with exceptions as noted in this report. Investigations of two additional SWMUs (which are summarized below) were addressed by GM through RCRA IM programs. The IMs at SWMU #30 (Former J-Lot Fill Area) and SWMU #32 (Former Coal Pile Storage Area) were successfully implemented and were subsequently approved by U.S. EPA. The two IM's were completed concurrently with the RFI Work Plan development and implementation and are summarized in separate reports. The seven SWMUs addressed through either an IM or this RFI are summarized below.

	SWMU	*Description*	*Program*
1)	#30	Former J-Lot Fill Area	IM
2)	#32	Former Coal Pile Storage Area	IM
3)	#3	Container Storage Area	RFI
4)	#29	Wastewater Treatment Plant	RFI
5)	#31	Former Surface Impoundment	RFI
6)	#33	Former South Retention Pond	RFI
7)	#34	North Retention Pond	RFI

The RFI was implemented in two phases to characterize the nature and extent of hazardous waste or hazardous waste constituents which may be present at each SWMU as a result of previous operations and/or releases. The potential chemical constituents and associated soil quality at each SWMU were investigated by collection of surface soils and installation of at least three boreholes at each SWMU. The borehole locations, borehole depths, number of samples collected, the parameters analyzed, and procedures/methodologies utilized to investigate each SWMU were based on historical operations for each SWMU. In addition, monitoring wells were installed and sampled at SWMU #3 and SWMU #31 during the Phase II RFI activities.

All boreholes were advanced with continuous split spoon sampling to depths ranging between 2 and 42 feet below grade (the deepest boring installed during the RFI). All sample collection, sample screening, sample analytical and equipment decontamination procedures were consistent with those outlined in the QAPP. Soil samples and QA/QC samples (duplicates, rinse blanks, etc.) selected for chemical analysis were submitted to Columbia Analytical Services, Inc. for one or more of the analyses identified below

- TCL VOCs, SVOCs and/or PCBs by U.S. EPA Methods 8260B, 8270C, and 8082, respectively;
- TAL metals by U.S. EPA 6010B, 6020, and/or 7470A;
- Total cyanide and sulfide by U.S. EPA Methods 9010B and 9030B, respectively; or
- U.S. EPA Appendix IX VOCs, SVOCs, PCBs (excluding pesticides, herbicides, dioxin, and furans) and/or Metals using the same analytical methods referenced above.

Groundwater samples were analyzed for TCL-VOC, TCL-SVOCs, TCL-PCBs, and TAL inorganics (both filtered and non-filtered).

The general geologic profile of the uppermost 42 feet of overburden soils consisted of a surficial engineered fill and a glacial clay till (which was consistent with geologic profiles identified during previous investigations). The surficial engineered fill materials encountered during the RFI were typically comprised of a sand or clay engineered fill material with occasional occurrences of slag and gravel backfill. The depth of fill material ranged from approximately 0.3 to 20 feet below grade (at SWMW #3 and #33, respectively). Below the fill material, the glacial deposit generally consists of a medium-textured, poorly stratified clay till with thin shallow, laterally discontinuous lenses of sands and silts.

During the Phase I investigation, groundwater monitoring wells were to be installed and sampled if the native porous media encountered throughout the study area was greater than 5 feet thick and the zone of saturation was continuous and greater than 2 feet thick. However, as summarized below, the saturated sand seams encountered within the glacial till deposits were laterally discontinuous, of limited vertical thickness, or absent altogether.

SWMU	*Sand Lenses*	*Depth Encountered (ft. bgs)*	*Thickness (ft)*
#3	1 (upper)	6 to 8	0.8 to 5.2
#3	2 (lower)	10 to 12	0.8 to 3.1
#29	1	11 to 12.6	0.6 to 2.7
#31	1	8 to 10	2.0 to 3.5
#33	0	(through 20 feet)	Not Applicable
#34	0	(through 40 feet)	Not Applicable

These native sand deposits/sand lenses encountered during the RFI did not meet the monitoring well screening requirements specified in the RFI Work Plan (i.e., greater than five feet of native sand and greater than 2 feet of saturated thickness throughout the study area). Therefore, no monitoring wells were installed and no groundwater samples were collected during the Phase I investigation. The RFI investigations were consistent with previous investigations which had indicated that there is no defined water table aquifer near the ground surface at the Facility. This occurrence is primarily related to the occurrence of a massive regional clay till which exists near surface in the area.

A second phase of investigation of the perched water table zone was completed at the request of U.S. EPA at SWMU #3 and SWMU #31. The second phase of investigation included the installation of a shallow monitoring well at SWMU #3 and SWMU #31.

A comprehensive summary of the organic and inorganic analytes detected at each SWMU, their reported concentrations, and the MDEQ industrial direct contact criteria, (used as the screening levels) for soil is presented in Tables 5.1 through 5.15. The perched water table zone results are presented in Table 5.16.

As presented in Tables 5.1 through 5.15, the organic constituents (VOCs, SVOCs, and PCBs) detected in soil during the RFI were predominately at near surface elevations within the surficial engineered fill materials. The relatively low-level concentrations of these constituents were separated from the laterally discontinuous sand seams (and lower till horizons) by low permeability, clay-rich, glacial till deposits (see geologic cross sections A-A' through G-G'; Figures 5.1 through 5.7). The physical properties of the organic constituents detected within the five SWMUs have relatively limited mobilities, which may also inhibit vertical migration. The limited number of VOC constituents detected during the RFI had concentrations that generally decreased significantly with depth. As a result, no Facility-derived constituents were identified to have migrated to lower elevations in the overburden clay till soils.

Of the inorganic constituents detected in soil during the RFI, only two of the metal constituents (arsenic and lead), at two of the sampling locations (both at SWMU #31), were above the MDEQ generic industrial DCC (used as the screening levels). All other analytes detected from the five SWMUs were below applicable MDEQ screening level criteria and do not require any further corrective action. The arsenic concentrations detected at SWMU#31 in BH-31-3, 4 to 6 feet (140 mg/kg), and BH-31-2, 1.0 to 1.5 feet (117 mg/kg), were both above the MDEQ industrial DCC screening level of 61 mg/kg. It should be noted that the mean concentration of arsenic at SWMU #31 was 52.5 mg/kg which is lower than the screening level of 61 mg/kg. In addition, the 95% UCL for arsenic exceeded the screening level of 61 mg/kg at 101.8 mg/kg.

The lead concentrations detected in BH-31-3, 4 to 6 feet (2,780 mg/kg), and BH-31-2, 1.0 to 1.5 feet (1,790 mg/kg), were both above the MDEQ industrial DCC screening level of 900 mg/kg. The mean and 95% UCL level for lead at SWMU #31 were 945.3 mg/kg and 1,864.0 mg/kg, respectively. A summary of the detected constituents, including their range, average, and 95% UCL, is summarized in Tables 5.17 through 5.21.

Based upon the exceedance of the arsenic and lead screening levels at SWMU #31, a Preliminary Risk Evaluation was completed to further evaluate the potential risks associated with SWMU #31 (Appendix F).

An access road currently exists through the area of SWMU#31 (see Figure 4.3 and 6.1). This access road is a paved single lane road for use by GM employees only to travel to and from the wastewater treatment plant (from the Pontiac East Assembly Plant). There are no sidewalks or decorative landscaping in the vicinity of SWMU#31. No industrial work activities occur in the vicinity of SWMU#31. Moreover, access to the road is secured by a guardhouse near the Pontiac East Assembly truck docks at the rear of the plant thereby further limiting access to trespassers, construction workers, or industrial workers. Under future Facility conditions, the only significant population identified as being potentially exposed to arsenic and lead, the COPCs as identified in the PRE, was construction workers. Exposures to trespassers (considered to be of extremely low frequency) and industrial workers (or landscapers) are expected to be mitigated by the presence of asphalt and topsoil/grass over the area of SWMU #31. It should be noted, however, that no further development or construction activities are currently planned for this area (i.e., this area was redeveloped as part of the Centerpoint Business Campus).

The PRE identified cancer risks at SWMU#31 associated with arsenic on the order of -1.07E-07 to -4.46E-07 for the Mean and RME, respectively. The hazard indices were below 1.0, the level of concern. The estimated additional risks of cancer are well below the U.S. EPA target cancer risk range of 10^{-6} to 10^{-4}.

The risk evaluation for lead identified a risk based remediation goal for lead of 5,904 mg/kg. All lead levels at SWMU#31 were below this RBRG and are currently covered by asphalt or topsoil/grass.

The Phase II investigation identified that no potable groundwater exist in the surficial water table zone immediately beneath the Facility. In addition, potable water use for the Facility and surrounding area is supplied by the City of Pontiac municipal water supply system. As a result, drinking water consumption is not a completed exposure pathway associated with the perched water table zone at the Facility. In addition, all results were below the Act 451, Part 201 industrial GCC. The industrial GCC are considered to be the most applicable screening levels for the perched water table zone identified at SWMU #3 and SWMU #31. This indicates that the perched groundwater analytical detections are below the level of human health concern for a potential perched water table zone direct contact exposure (e.g., utility trench construction activities).

Based upon the fact that all concentrations were either below applicable industrial land-use based DCC screening levels (SWMU #3, #29, #33, and #34), or did not pose unacceptable risks (SWMU #31), for an industrial land use exposure scenario, the Corrective Measures Study (CMS) Report will evaluate the necessity for and application of institutional controls (e.g., security, deed restrictions, Notice of Approved Environmental Remediation (NAER) filed with the Register of Deeds, etc.) at each of the SWMUs which were investigated/remediated during the IM and RFI activities implemented at the Facility.

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